

## BMP #49 - Bioretention Basin

### Targeted Pollutants

75% Sediment

45% Phosphorus



Trace metals



Bacteria



Petroleum hydrocarbons

### Physical Limits

Drainage area 25-50 ac

Max slope 5%

Min bedrock depth 3 ft

Min water table 2 ft

SCS soil type CD

Freeze/Thaw fair

Drainage/Flood control yes

### DESCRIPTION

A bioretention basin is an artificial wetland intentionally constructed on a nonwetland site for the purpose of managing stormwater runoff. The primary function of a bioretention basin is to provide runoff treatment of both conventional pollutants and nutrients, using a permanent pool of water which has extensive shallow marsh area. A secondary function is to provide recreational opportunities, wildlife habitat, and to be an aesthetic amenity.

### APPLICATION AND LIMITATIONS

A well-planned bioretention basin can meet a variety of objectives. These may include protection of infrastructure and property, improving water quality, and providing recreational opportunities. Due to their emphasis on vegetation, bioretention basins provide greater habitat enhancement than conventional wet ponds.

In order to serve as a multi-purpose facility the bioretention basin should function in such a manner as to be compatible with overall stormwater systems both upstream and downstream. This provides a watershed approach to stormwater management as well as local flood control.

In planning bioretention basins, it should be kept in mind that the goal of improved water quality downstream may conflict with certain desired uses of the facility. It is only logical that if the bioretention

basin is used to remove pollutants, the water quality within the bioretention basin itself will be lowered, thus reducing the applicability for uses such as recreation, aesthetics, and natural habitat. If the facility treats runoff from large paved areas, high levels of metals and other pollutants may be trapped in sediments in the facility.

## DESIGN PARAMETERS

### Site Constraints

Many of the same site constraints apply as in BMP #45, Wet Pond (Conventional Pollutants). The primary difference is that a bioretention basin is much shallower, requiring a greater surface area to contain the desired runoff volumes. A constant supply of water throughout the summer is necessary as well as a shallower depth.

The following hydrologic factors need to be considered to ascertain whether the site being considered is suitable for a bioretention basin.

- a. Flow. A careful hydrologic analysis of flow is needed to determine depth-area relationships. This should be done by a qualified hydrologist before construction of the bioretention basin. Excessive fluctuations in water level should be avoided.

- a. Climatic Conditions. Overall climatic conditions determine the types of plants that may be used and the seasonability of flow rates.
- a. Groundwater Conditions and Soil Permeability. Permeable soils may require that a bioretention basin be lined.

### **Bioretention basin Configuration and Geometry**

The bioretention basin volume should be equal to the runoff volume of 1/3 of the 2-year, 24-hour design storm. Review Appendix G-2 for additional information on sizing detention facilities.

A forebay, a deeper area where sediments can settle out, should be established along the bioretention basin inflow points to capture sediment. The forebay should have a water depth of about 3 feet and may occupy up to 25 percent of the normal pool area.

A bioretention basin has different surface area-pool relationships than a wet pond:

50% of the area = 0.5 feet (approximately)

15% of the area @ 0.5 to 1 foot

15% of the area @ 2 to 3 feet

20% of the area 3+ feet deep with a maximum of 6 feet

### **Soil**

The soil in which the vegetation is planted should be appropriate for the plants selected. Either soil tests indicating the adequacy of the soil or a soil enhancement plan should be submitted with the overall bioretention basin design.

To maintain a permanent pool of water in a bioretention basin, inflow from stormwater, baseflow, and groundwater must be greater than outflow via infiltration, evapotranspiration, and discharge. If the rate of infiltration is high and a permanent pool cannot be maintained, a clay liner (or equivalent) will be necessary. The discharge rate may also be reduced to increase residence time.

The soil substrate must, however, be soft enough to permit easy insertion of the plants. If the basin soil is compacted or vegetation has formed a dense root mat, the upper 6 inches of soil should be disked prior to plating. If soil is brought in, it needs to be laid at least 4 inches deep in order to provide sufficient depth for plant rooting. Soil may be taken from a wetland or from ditch cleaning operations if available. However, if this type of soil is used, the plant species composition may be influenced by volunteer vegetation. Studies have shown up to 32,430 seeds per square meter in marsh soils. Enriching non-wetland soils with organic matter seems to increase vegetative yields.

### **Vegetation Establishment**

Wetland-associated plants will establish themselves naturally in shallow, wet ponds. It may be beneficial, however, to accelerate marsh establishment by planting appropriate native vegetation in shallow areas.

Certain wetland plant species have a greater capacity for pollutant assimilation and are less maintenance intensive than others.

Artificial establishment of vegetation is done to influence future plant species composition and to establish a vegetated marsh as quickly as possible. Complete coverage and optimum treatment potential can often take five years or more. Biodetention basins with a smaller vegetative cover can still significantly reduce pollution.

Selection of vegetation needs to be done by a wetlands specialist. The selection will be based on climate, hydroperiod of the biodetention basin, sensitivity to pollution, and aesthetic appeal. Grazing pressures and detrimental effects of wind, waves, and water currents will also need to be taken into account. A well planned biodetention basin will also need a diverse mixture of floating, emergent and submergent plants. Above all, the plants will need to be able to withstand the pollutant concentration of the incoming water and tolerate some fluctuation in the water level of the biodetention basin.

Marsh establishment in facilities that also serve as temporary sediment basins may be difficult during construction due to the need for frequent clean-out of accumulated sediment. Wet ponds should be designed with the need for periodic sediment removal in mind. To continue functioning, marshes also require periodic sediment removal. Sediment should be removed from the deepest parts of the basin where vegetation is sparse. Heavily vegetated areas should be disturbed as little as possible. Overhead scooping equipment works well for dredging selected portions of marsh areas.

### **Wildlife**

The species of vegetation chosen should maximize heterogeneity and value to all types of wildlife. Although not required, measures to further enhance habitat for wildlife are encouraged. Maximizing vegetation density around the biodetention basin will discourage the entry of domestic animals that would prey on wildlife. In larger biodetention basins, provision of an island for nesting birds is encouraged.

### **Overflows**

Detention facility design must take into consideration the possibility of overflows. An overflow device must be installed in all facilities to bypass flows over or around the restrictor system and possibly the marsh portions of the facility. The most common overflow event is snowmelt, but overflows may also result from higher intensity or longer duration storms than the design storm or result from plugged orifices or inadequate storage due to sediment buildup in the facility.

Biodetention basins are better at polishing water quality than they are at lessening flooding problems.

### **Gravity Drain**

If vegetation is to be harvested, a gravity drain should be provided similar to that mentioned in BMP #39.

## **CONSTRUCTION GUIDELINES**

Widely acceptable construction standards and specifications such as those developed by the USDA - Soil Conservation Service (SCS) or the U.S. Army Corps of Engineers for embankment ponds and reservoirs may aid in building the impoundment. Additional information is also available from the Idaho Transportation Department's Design manual.

## **MAINTENANCE**

The presence of wetlands in established urban areas is perceived by many people to be undesirable. They are often thought of as mud holes where mosquitoes and other insects breed. Due to its ability to attract wildlife, the bioretention basin can become a welcomed addition to a residential community. Constructed fresh water marshes can provide miniature wildlife refuges, and while insect populations are increased, insect predators also increase, often reducing the problem to a tolerable level. Nevertheless, local government and homeowners associations may wish to drain the ponds during late spring and summer if there is sufficient concern. However, it is imperative that the vegetation in shallow marsh areas not die off during drawdown periods, otherwise the pollutant removal effectiveness of the wet pond can be severely impacted. In addition, the decaying vegetation can create nuisance conditions.

If the facility is a permanent one, some experts suggest harvesting the marsh vegetation in the fall before it dies and releases stored nutrients back into the system. Harvesting should be minimized, especially if heavy equipment is used that will compact the soil. Trash and debris removal should also be done regularly to avoid the facility becoming a convenient dumping ground for trash, construction debris, and yard waste.

### **Safety, Signage And Fencing**

As in BMP #45, conventional wet ponds. The use of thorny vegetation as a barrier instead of fencing enhances the habitat aspects of a bioretention basin.

### **Heavy Metal Contamination**

Studies have shown high accumulation rates of lead, zinc, and copper on and near heavily traveled highways and streets. Runoff from highways and streets can be expected to carry significant concentrations of these heavy metals. If a significant portion of the drainage area into the bioretention basin consists of highways, streets, or parking areas or other known sources of heavy metal contamination, there is a potential environmental health hazard. This is of more concern with the bioretention basin than the conventional wet pond because of the attractiveness to wildlife of the marsh areas.

